Fish and Fishery Products Trade by India: Trends, Competitiveness, and Comparative Advantage

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ABSTRACT

This study analyzes the trends and determines the comparative advantage and competitiveness of India's fish and fishery products trade in the world market and of India's exports to 10 major destinations over the period of 2000–2021. We use the revealed symmetric comparative advantage (RSCA) index to quantify India's comparative advantage in exporting fish and fishery products and the Vollrath index to measure the revealed competitiveness of the country's fish and fishery products trade. We collected relevant data at Harmonized System (HS) four-digit level from the UN Commodity Trade (UN Comtrade) database. Our analysis shows that India has a revealed comparative advantage (RCA) in exporting fish and fishery products to the world market. Specifically, India has a comparative advantage in exporting frozen fish, crustaceans, and mollusks; but it has a comparative disadvantage in exporting live fish, fresh and chilled fish, fish fillets and other fish meat, and dried/salted/in-brine and smoked fish to the world market. In terms of individual destinations, India has RCA in exporting live fish to Hong Kong; fresh and chilled fish to UAE (in recent years); frozen fish to China, Hong Kong, Thailand (recent years), and Vietnam (recent years); fish fillets and other fish meat to Japan (recent years); dried fish to Hong Kong; crustaceans to Japan, the US, and Canada (recent years); mollusks to the EU, Thailand (recent years), and Vietnam (recent years); and other aquatic invertebrates to Vietnam. India has a comparative disadvantage (RCD) in exporting fresh and chilled fish to the EU, Japan, the US, and Vietnam, and fish fillet and other fish meat to the US, Canada, and Vietnam. The COVID-19 pandemic has negatively affected India's export, comparative advantage, and trade competitiveness of fish and fishery products. India's RCA and competitiveness in exporting fish and fishery products decreased in 2018–2020, but the RCA and competitiveness increased by 2021.

Keywords: fish and fishery products, comparative advantage, competitiveness, Balassa index, RSCA index, Vollrath index

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INTRODUCTION

Global trade of fish and fishery products had expanded rapidly in recent decades. Over the last 20 years, global export of fish and fishery products tripled from USD 40.68 billion in 2000 to USD 120.61 billion in 2018. However, the COVID-19 pandemic has reduced the global export of fish and fishery products to USD 106.13 billion in 2020 (12% less than that in 2018) and USD 119.50 billion in 2021 (1% less than that in 2018) (UN Comtrade 2022).

In the past two decades, India had significantly progressed in its fish and fishery production, becoming the principal player in the world's fish and fishery products market. To date, it is the second-largest aquaculture producer in the world after China. In 2020, India had an 8 percent contribution to the world production of fish and fishery market. It was also the top producer of inland water catches and the sixth-largest marine capture fisheries producer in 2020, with inland water catches and marine capture fisheries production amounting to 1.8 million tons and 3.71 million tons (4.7% of the world marine capture fisheries production), respectively (FAO 2022). India was also the fifth-largest exporter of aquatic products in 2020, with an export value of USD 5.8 billion (FAO 2022). The fisheries sector has contributed about 1.24 percent to India's gross value added (GVA) and over 7.28 percent to the agricultural GVA in fiscal year 2021–2022 (GOI 2022). The fish and fishery products industry has also been a major contributor to India's total exports, with a 2.3 percent contribution to total exports in 2018. The country has also been importing fish and fishery products, with fish and fishery product imports amounting to USD 143.96 million in 2020. However, India's trade in fish and fishery products has been affected by the COVID-19 pandemic.

Exports provide an opportunity to bring foreign currencies into a country. Under free trade conditions, countries can specialize in and become net exporters of those goods that they have comparative advantage over (De Benedictis and Tamberi 2001). The classical economist David Ricardo first expounded the concept of comparative advantage in 1816 (Ruffin 2002). A country with a comparative advantage over another country in producing a good must have relatively lower opportunity costs in production as compared to other countries.

Measuring comparative advantage has always been difficult in international trade theory. "Revealed" comparative advantage (RCA) is the comparative advantage that can be measured through observed data and can be derived from available trade patterns. Gopal et al. (2009) examined the RCA of finfish exports from India from 2001 to 2005 and found that finfish did not have any comparative advantage among the total marine products exported during the period.

Exporting countries face intense competition from other exporters, and the importance of export destinations changes over time. The ability to export commodities from one country to another and compete with other exporters is a dynamic phenomenon. It changes with production level, processing capabilities, export-import policies, investments in processing, and marketing infrastructure. Since 1991, India has liberalized its export-import policies for agricultural trade and for fish and fishery products trade. Over the years, India has invested significantly in upgrading its seafood processing infrastructure and other essential public services to meet the requirements of importing countries, especially in Hazard Analysis Critical Control Points (HACCP). As a result, India's export of fish and fishery products responded differently, and its comparative advantage levels in the global market are expected to change significantly. Therefore, studying export trends, export growth, comparative advantage, and export competitiveness in India's fish and fishery products trade is essential.

In this study, we analyze the trends in India's export and import of fish and fishery products and identify the major export destinations and import sources from 2000 to 2021. Moreover, we estimate India's comparative advantage and competitiveness in exports and identify the countries where India

has RCA in its fish and fishery export products. Lastly, we articulate the implications of our findings for India's fish and fishery products industry.

MATERIALS AND METHODS

Data

Fish and fishery products (fish and crustaceans, mollusks, and other aquatic invertebrates) are traded globally under the eight main categories listed in the UN Commodity Trade (UN Comtrade) database in the four-digit Harmonized System (HS) codes starting from HS 0301 to HS 0308. For ease of discussion and understanding, we refer to the fish and fishery products in this study as follows: live fish (HS 0301), fresh or chilled fish (HS 0302), frozen fish (HS 0303), fish fillet and other fish meat (HS 0304), dried/salted/in-brine and smoked fish (HS 0305), crustaceans (HS 0306), mollusks (HS 0307), and other aquatic invertebrates (HS 0308).

Analytical Techniques

In this paper, we estimate the comparative advantage of India's fish and fishery export products. In 1817, David Ricardo pointed out that a country has a comparative advantage in producing a good if the opportunity cost of producing that good in terms of other goods is lower in that country than in other countries (Krugman, Obstfeld, and Melitz 2018). The Ricardian model postulates that "trade between two countries can benefit both countries if each country exports the goods in which it has a comparative advantage" (54).

The two commonly used methods in economics literature to measure comparative advantage are the domestic resource costs (DRC) approach and the revealed comparative advantage (RCA) approach (Leung and Cai 2008). The DRC approach utilizes social profitability to determine comparative advantage; the greater the profitability is, the stronger the advantage would be (Monke and Pearson 1989). On the other hand, the RCA approach uses ex-post specialization patterns to infer comparative advantage patterns (Leung and Cai 2008). In other words, a country's actual high specialization in an activity implies that it has a strong comparative advantage in that activity (Balassa 1965). The comparative advantage measured by the RCA index is called "revealed" comparative advantage because market shares reflect competitiveness, albeit they do not explain the sources of competitiveness. Comparative advantage reflects relative competitiveness while competitiveness is measured through market shares (Cai, Leung, and Loke 2007). The larger the country's market share in a product's sales, the more competitive it is relative to other suppliers in the market.

Many empirical studies have measured comparative advantage using the Balassa (1965) index. However, the Balassa index has some limitations. Vollrath (1991) pointed out two limitations: (1) the double-counting problem that can occur in the commodity and/or country considered and (2) the simultaneous consideration on the import side. The latter means that the commodities and countries in the denominator should exclude the commodity and country mentioned in the numerator to avoid the double-counting problem.

Moreover, Dalum, Laursen, and Villumsen (1998) observed that the Balassa index is asymmetric. Countries with revealed comparative disadvantage (RCD) in producing a commodity get an index value between 0 and 1. On the other hand, countries with comparative advantage in producing an item receive a value between 1 and infinity. The authors further asserted that the values on one side of unity cannot be compared with those on the other side as it prevents from making any meaningful comparisons between the variabilities in RCA and RCD. Further, using asymmetric RCA in econometric analysis (e.g., regression analysis) leads to biases as it assigns larger weights to values above 1 compared to those below.

Several RCA indices based on the basic RCA concept have been proposed over the years (Bowen 1983; Yeats 1985; Vollrath 1991; Lafay

1992; Memedovic 1994; Dalum, Laursen, and Villumsen 1998). Vollrath (1991) suggested an approach that accounts for trade (both export and import) in the estimation and provided three alternative measures of comparative advantage: relative export advantage (RXA), import specialization index (RMA), and relative trade advantage (RTA). These measures are commonly known as the Vollrath indices. The Vollrath indices also measure the difference between the revealed comparative export advantage and the relative import specialization index. To fix the asymmetric problem, meanwhile, Dalum, Laursen, and Villumsen (1998) proposed the revealed symmetric comparative advantage (RSCA) index, a quasi-logarithmic transformation of the Balassa index that delivers a normal distribution for the resulting index. Laursen (2015) compared RSCA to other measures of international trade specialization and concluded that RSCA—on balance—is the best measure of comparative advantage.

Balassa index is usually used to measure export competitiveness (Kiet and Sumalde 2008; Kuldilok, Dawson, and Lingard 2013) and comparative advantage in export (Ling, Leung, and Shang 1996; Shang 1998).[1] On the other hand, the Vollrath indices are used to measure comparative advantage and trade competitiveness (Seyoum 2007; Bojnec and Ferto 2009).[2]

Khai, Ismail, and Sidique (2016) examined the consistency between the two comparative advantage measures (i.e., Balassa index and Vollrath indices) to estimate the comparative advantages of Malaysian shrimp products over those of other Asian countries (i.e., China, India, Indonesia, Thailand, and the Philippines). The study concluded that the Balassa index is highly consistent with the relative RXA index, indicating that the double-counting problem in the Balassa index was not significant in measuring the export competitiveness of the Malaysian shrimp sector.

Accordingly, we use the RSCA index of Dalum, Laursen, and Villumsen (1998) in this study to quantify the comparative advantage of India's fish and fishery products. Meanwhile, we use the RC index developed by Vollrath (1991) or the Vollrath index to measure the competitiveness of the same.

Balassa Index of Revealed Comparative Advantage

The Balassa index determines whether a country has an RCA in actual export. Export of any product from a country is affected by many factors, such as cost-effective production process and technology, transportation and necessary logistics for export, connection with importing networks in foreign countries, and ability to address all the requirements demanded by the public and private agencies as well as all the needs of customers in the export destinations. The RCA index considers all these factors and provides a realistic estimate of the country's comparative advantage situation. The RCA index of a fish and fishery product I exported from country j can be expressed as

$$RCA_{ij} = \frac{\left(\frac{X_{ij}}{X_j}\right)}{\left(\frac{X_{iw}}{X_w}\right)} \quad (1)$$

where:

X_{ij} = export of fish and fishery product i from country/region j;

X_j = export of fish and fishery product i from country/region j;

X_{iw} = world exports of the fish and fishery product i; and

X_w = rest of the world's export of all fish and fishery products.

1 Other similar literature include Traesupap, Matsuda, and Shima 1999; Polymeros, Tsakiridou, and Mattas 2005; Kiet and Sumalde 2008; Xinhua 2008; Wijnands et al. 2008; Ma and Xiao 2010; Wijnands et al. 2010; Chandran and Sudarsan 2012; Wati, Chang, and Mustadjab 2013; Herath and Wijewardene 2014; Rani, Immanuel, and Ranjan 2014; Rani and Kumar 2016; Granabetter 2016; Chang, McAleer, and Nguyen 2016; Luo, Han, and Li 2017; Zhang and Chen 2019; Adhikari and Deb 2020; Amirnejad, Ahmadzade, and Kenari 2020; Destiningsih et al. 2020; Tan, Wu, and Qu 2020; Oktopura et al. 2020; Thein 2020; and Yusuf et al. 2021.

2 Additional references are Gopal et al. 2009; Bojnec and Ferto 2012; Ismail et al. 2013; and Khai, Ismail, and Sidique 2016

The RCA index ranges from 0 to infinity, with 1 as the breakeven point. An RCA of less than 1 means that the product does not enjoy a comparative advantage, whereas a value above 1 indicates RCA. Note that the RCA index is not symmetrical as it cannot compare both sides of the breakeven point.

In this paper, we calculate the RCA of the regional market or individual country by disaggregating the RCA. Specifically, we estimate RCA at the regional level for EU, while it is at the country level for all the other countries. To disaggregate RCA at the regional and bilateral levels, we adapt equation (1) as follows:

$$RCA_{ij}^{R} = (X_{ij}^{R} / X_{j}^{R}) / (X_{ij} / X_{j}) \quad (2)$$

where:

RCA_{ij}^{R} = RCA index for exports of product i from country j into country/region R;

X_{ij}^{R} = exports of product i from country j to country/region R;

X_{j}^{R} = exports of country j to country/region R;

X_{ij} = total exports of product i from country j; and

X_{j} = total exports of fish and fishery products by country j.

If the calculated value of RCA_{ij}^{R} exceeds 1, then we can conclude that country j has a comparative advantage in exporting fish and fishery product i to the reference market (country/region) R. Regional- or country-level RCA identifies a product that has export competitiveness to that particular country or region.

Revealed Symmetric Comparative Advantage

As mentioned earlier, Balassa's RCA index is asymmetric. To fix this problem, Dalum, Laursen, and Villumsen (1998) proposed a transformation of the RCA index and called this the revealed symmetric comparative advantage (RSCA). We then compute RSCA using equation (3):

$$RSCA_{India,i} = \frac{RCA_{India,i} - 1}{RCA_{India,i} + 1} \quad (3)$$

where $RCA_{India,i}$ is the Balassa RCA index for India vis-à-vis the world in commodity i. The values of RSCA range between −1 and +1. A positive RSCA value implies that India has a comparative advantage, whereas a negative value indicates India's comparative disadvantage over the world in commodity i.

Estimation of Revealed Competitiveness

We use the Vollrath index to measure the RC index. The latter index considers both export and import and is calculated as the difference between RXA and RMA.

RXA = RCA (calculated according to equations 1 and 2).

The RMA can be computed as

$$RMA_{i}^{j} = \left(\frac{M_{ij}}{\sum_{i=1}^{n} M_{ij}}\right) / \left(\frac{\sum_{i=1}^{n} M_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{t} M_{ij}}\right) \quad (4)$$

where:

M_{ij} = import of commodity i from the country/region j, and

n, t = set of the countries/region and set of the commodities, respectively, that the country is importing

The revealed competitiveness can be expressed as

$$RC_{i}^{j} = lnRXA_{i}^{j} - lnRMA \quad (5)$$

A positive RC index indicates comparative advantage for exporting the product, while a negative value indicates comparative disadvantage for exporting the product.

RESULTS AND DISCUSSION

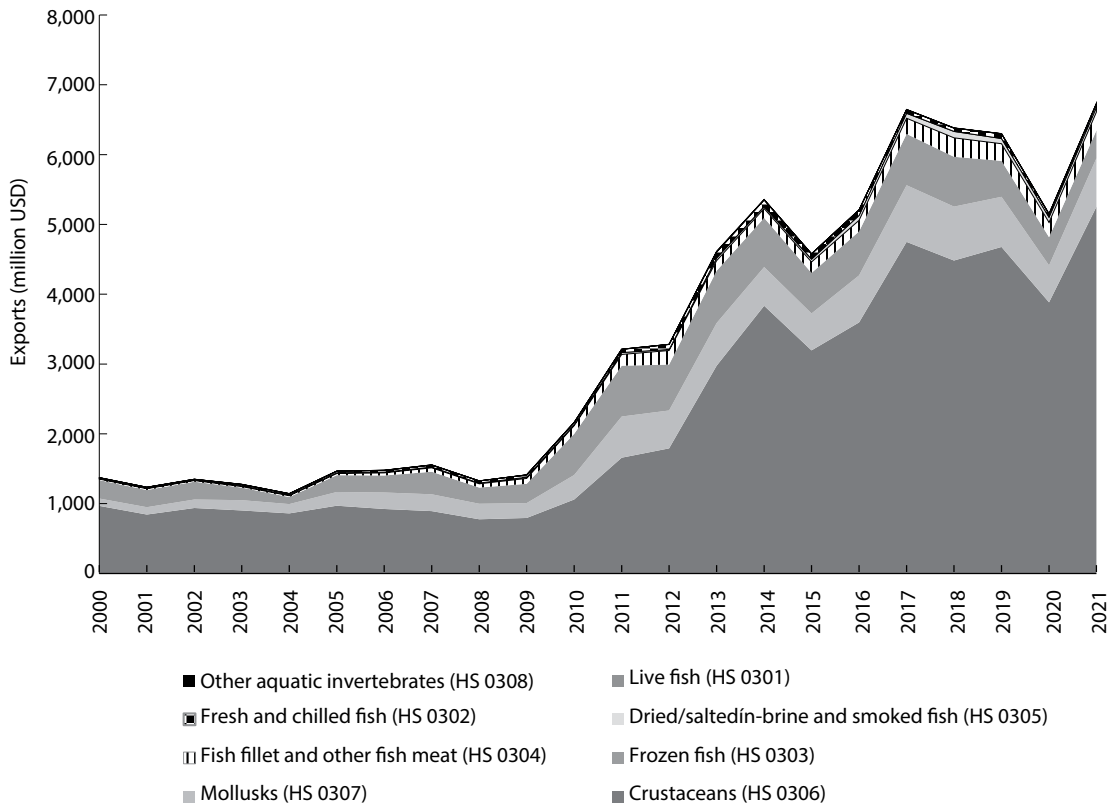
Trends in India's Fish and Fishery Products Trade

India has been trading live fish, fresh or chilled fish, frozen fish, fish fillet and other fish meat, dried/salted/in-brine and smoked fish, crustaceans, mollusks, and other aquatic invertebrates. Except for one (other aquatic invertebrates), all commodities were traded during the entire study period (2000–2021). The trading of other aquatic invertebrates has been reported since 2012 and has the lowest contribution to India's fish and fishery export products.

Global trade of fish and fishery products has expanded over the years. The UN Comtrade reports that 120 countries and territories exported fish and fishery products to the world market in 2021. Between 2000 and 2021, the total value of global export increased by 2.9 times from USD 40.68 billion to USD 119.50 billion. During the same period, global imports have increased by 2.8 times from USD 46.79 billion to USD 129.31 billion (UN Comtrade 2022).[3] In 2021, crustaceans had the highest contribution (25.53%) to the world fish and fishery products trade, followed by fresh or chilled fish (18.94%), frozen fish (17.82%), fish fillet and other fish meat (18.72%), mollusks (11.25%), dried/salted/in-brine and smoked fish (4.90%), live fish (1.80%) and other aquatic invertebrates (0.58%).

3 Imports are generally reported on cost, insurance and freight (CIF) basis, while exports are reported on a free on board (FOB) basis. For this reason, import values tend to be higher than export values.

Figure 1. Value (USD million) of India's exported fish and fishery products, 2000–2021



Source of raw data: UN Comtrade (2021)

Between 2000 and 2021, India's fish and fishery export products to the world increased by 4.9 times from USD 1,372.34 million to USD 6,734.83 million (Figure 1). During this period, India's exports of fish and fishery products grew by 10.45 percent annually. Three major commodities (crustaceans, mollusks, and frozen fish) accounted for more than 90 percent of the country's total fish and fishery export products. In triennium ending (TE) 2021 (i.e., average export of 2019–2021), India's highest-valued export commodity was crustaceans (USD 4,605 million), with a share of 76 percent of the total fish and fishery export products. Crustaceans was followed by mollusks (10.7% share), frozen fish (7.2%), fish fillet and other fish meat (4.0%), and dried/salted/in-brine and smoked fish (1.2%).

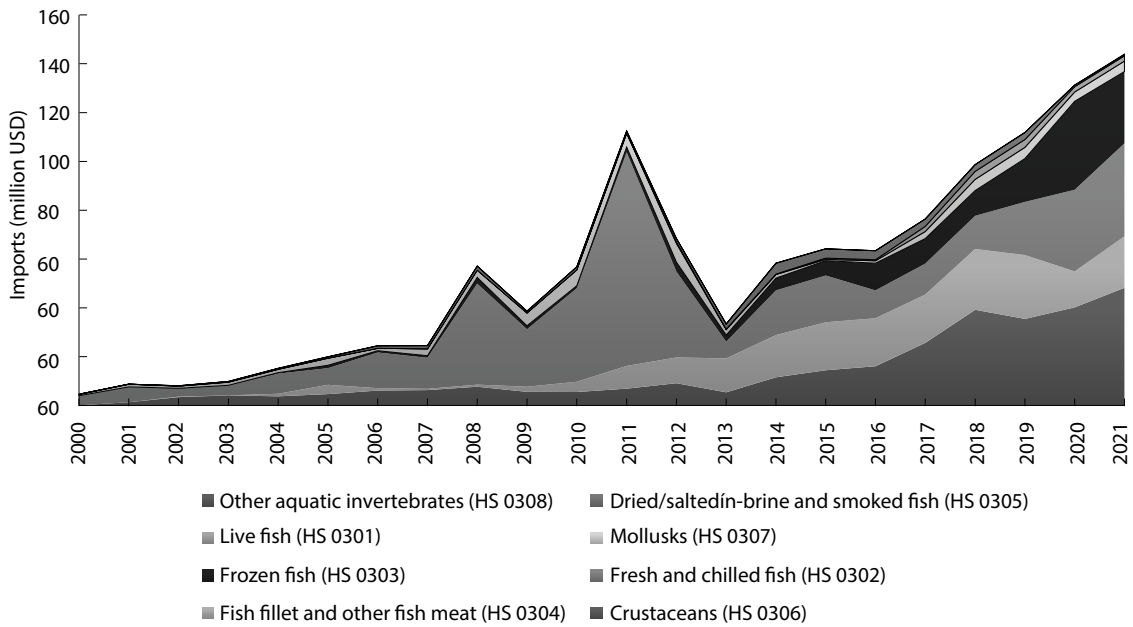
Over the last two decades, India's fish and fishery import products have increased by 31.4 times from USD 4.59 million in 2000 to USD 143.96 million in 2021 (Figure 2) (UN Comtrade 2022). Between 2000 and 2021, imports of fish and fishery products had an annual growth rate of 15.34 percent. Fish and fishery import products was about 2.1 percent of the country's total fish and fishery export products in 2021. Despite the higher import growth rate, India has been a net exporter of fish and fishery products during the entire study period. The country's trade surplus increased by 4.8 times from USD 1.37 billion in 2000 to USD 6.59 billion in 2021.

Major Export Destinations and Import Sources

In 2021, India exported fish and fishery products to 114 countries/destinations. In terms of the export value of these commodities, the US, China, EU, Japan, Vietnam, Thailand, the UAE, Canada, Russia, and Hong Kong were the top 10 destinations of India's fish and fishery exports in TE2021 and accounted for more than 90 percent of India's exports.

In TE2010 (average of 2008–2010), the EU was the top destination of India's fish and fishery products, which accounted for 30.2 percent of total export. This was followed by the US (14.8%), Japan (14.3%), China (8.5%), Hong Kong (6.8%),

Figure 2. Value (USD million) of India's imported fish and fishery products, 2000–2021



Source of raw data: UN Comtrade (2021)

Table 1. Major destinations of India's exported fish and fishery products, 2000–2021

Export Destination	Average Annual Export (Million USD)				% Change in TE2018 Compared to TE2010	% Change in TE2021 Compared to TE2018
	TE2002	TE2010	TE2018	TE2021		
USA	283.0	242.5	1,840.7	2,231.3	659	21.2
China	103.4	139.5	283.7	1,100.7	103	288.0
EU (including UK)	251.5	494.0	1,003.1	883.6	103	–11.9
Japan	404.7	233.1	409.4	414.5	76	1.2
Vietnam	13.5	49.5	1,411.8	288.4	2,750	–79.6
Thailand	32.0	62.3	256.8	208.1	312	–19.0
UAE	52.8	48.7	178.4	176.3	266	–1.2
Canada	16.9	38.6	102.2	114.0	165	11.5
Russia	0.9	10.4	68.6	102.8	562	49.9
Hong Kong	16.2	111.7	84.9	74.4	–24	–12.4
WORLD	1,319.4	1,634.5	6,080.0	6,061.7	272	–0.3

Source of raw data: UN Comtrade (2021)
Notes: TE2002, TE2010, TE2018, and TE2021 indicate the average for 2000–02, 2008–10, 2016–18, and 2019–21, respectively.

Thailand (3.8%),Vietnam (3.0%), the UAE (3.0%), and Canada (2.4%) (Table 1). In TE2010, the top three destinations (the EU, the US, and Japan) accounted for 59.3 percent of India's total fish and fishery export products.

In TE2018 (average of 2016–2018), the shares of the top 10 countries changed substantially. The US, which was the second topmost destination in TE2010, was the topmost export destination in TE2018 with a share of 30.3 percent of India's total fish and fishery exports. The US's relaxation of its anti-dumping duties has contributed to the rapid growth in fish and fishery exports to the US after 2010 (Nisar, Yongtong, and Kumar 2020). In TE2018, Vietnam became the second most important destination with a share of 23.2 percent. This was followed by the EU (16.5%), Japan (6.7%), China (4.7%), Thailand (4.2%), the UAE (2.9%), Canada (1.7%), Hong Kong (1.4%), and Russia (1.1%).

Developed countries import mainly frozen fish, fish fillets, crustaceans, and mollusks; these commodities contribute more than 90 percent to India's total fish and fishery exports. When we compare the export shares between TE2010 and TE2018, the trend indicates that the market has been shifting from the EU and Japan to Vietnam and the US. In TE2018, the top three export destinations (US,Vietnam, and the EU) accounted for 70 percent of India's fish and fishery export products. Hence, the trade relationship with these three partners is critical in determining India's success in exporting fish and fishery products. Except for China and Vietnam, other Asian countries (e.g., Hong Kong, Japan, Thailand, and UAE) had a minor share of India's fish and fishery products exported in TE2018.

In the last three years, no significant change in the average export value could be observed in TE2021, albeit average export value fluctuated significantly across months and destinations. During this period, the pandemic, trade restrictions, and the rapid rise in global inflation affected the trade of fish and fishery products. In TE2021, the value of India's exports to the world declined by only 0.3 percent from USD 6.08 billion in TE 2018 to USD 6.06 billion in TE2021 (Table 1). However, fish and fishery exports to China, Russia, the US, and Canada were 288.0 percent, 49.9 percent, 21.2 percent, and 115.0 percent higher in TE2021 than in TE2018, respectively. On the other hand, exports to Vietnam, Thailand, the EU, and Hong

Kong declined by 79.6 percent, 19.0 percent, 11.9 percent, and 12.4 percent in the same year, respectively.

The rapid rise in exports to China can be linked to the strengthened ties between China and India in 2018–2020. China is the world's largest importer of live lobsters. The regulatory trade measures between the US and China diverted China's lobster imports from the US to other countries. Accordingly, China's imports of live lobster from India increased in 2019 and 2020. Also, the routing of shrimp from India to China through Vietnam declined; instead, seafood exports (i.e., shrimps) from India to China significantly increased (Ministry of Commerce and Industry, India 2022).

Exports to Vietnam suddenly decreased in 2020, which may be due to Vietnam's difficulty in exporting seafood to the EU. In 2020, the volume of Vietnam's seafood export to the EU decreased by 5.7 percent or by USD 959 million due to the "yellow card" issued to the country and to the negative impacts of the COVID-19 pandemic. The European Commission issued a "yellow card" to Vietnam in October 2017, further warning the country that it could issue a "red card" and ban its seafood from entering the EU unless Vietnam did more to tackle illegal, unreported, and unregulated fishing (Dao 2021).

Trade between India and Vietnam has rapidly expanded largely due to the ASEAN-India Free Trade Area (AIFTA) and due to Vietnam's rapidly growing export-oriented seafood processing industry. The AIFTA, which came into effect on 1 January 2010, positively contributed to the trade between the two countries. Vietnam imports shrimp and other fish as raw materials for their seafood processing plants. Over the years, the Vietnamese seafood processing industry has quickly grasped the trend of integration. Accordingly, it effectively exploited the advantages of free trade agreements and gradually asserted itself as one of the key export industries (VASEP 2021). Vietnam has the privilege of importing fish and fish products as raw materials with zero duty from India and of exporting processed seafood to many countries, including the main markets, the EU, Japan, and the US. Vietnam enjoys preferential access (zero or minimum duty) to many countries and regions, including the EU.

In 2021, India imported fish and fishery products from more than 50 countries. Accordingly, the value of imported fish and fishery products increased by 31.4 times from USD 4.59 million in 2000 to USD 143.96 million in 2021 (Figure 2). Crustaceans were the major imported fish and fishery products in TE2021 (average of 2019–2021). In 2021, crustaceans contributed 32 percent to total imported fish and fishery products, followed by fresh and chilled fish (24.1%), frozen fish (21.5%), fish fillet and other fish meat (16.0%), mollusks (3.3%), live fish (2.0%), dried/salted/in-brine and smoked fish (1.0%), and other aquatic invertebrates (0.1%). The top four commodities accounted for more than 90 percent of total imports. The data clearly indicate that crustaceans and frozen fish were India's important export and import commodities. India's import was only 2.1 percent of its total exported fish and fishery products in 2021.

There was a significant shift in import sources. In TE2010, Bangladesh was India's topmost source of imported fish and fishery products, with import value amounting to USD 35.26 million and accounting for 69.4 percent of the country's total imported fish and fishery products (Table 2). In TE2018, however, Bangladesh had a share of only 21 percent of India's total imported fish and fishery products and ranked second after Vietnam (21.9%). This decline can be linked to Bangladesh's ban on exporting Hilsha fish from August 2012 to January 2018. Thereafter, Bangladesh had imposed an export quota on Hilsha fish.

In TE2018, the share of India's top 10 import sources of fish and fishery products was 82.5 percent. Based on both import and export trends, the US, Vietnam, and the EU have been the major trade partners of India over the years. In TE2021, import value and import sources significantly changed. Specifically, India's imported fish and fishery products from the world was 62.2 percent

Table 2. Major sources of India's imported fish and fishery products, 2000–2021

Import Source	Average Yearly Import (Million USD)				% Change in TE2018, Compared to TE2010	% Change in TE2021, Compared to TE2018
	TE2002	TE2010	TE2018	TE2021		
Bangladesh	4.44	35.26	16.67	29.50	–53	77.0
USA	0.63	0.32	9.47	28.20	2,839	197.8
Myanmar	0.39	0.11	3.70	14.74	3,198	298.4
Vietnam	NA	1.25	17.39	13.35	1,288	–23.2
Oman	0.36	0.95	3.10	11.45	225	269.4
EU (including UK)	0.19	0.71	3.75	5.42	427	114.2
Norway	0.11	0.74	1.77	2.56	140	44.6
Thailand	0.02	1.09	2.62	1.68	140	–35.9
Singapore	0.09	0.51	1.66	0.73	222	–56.0
Yemen	0.17	1.83	5.14	0.08	181	–98.4
WORLD	7.15	50.84	79.48	129.03	56	62.3

Source of raw data: UN Comtrade (2021)
Notes: TE2002, TE2010, TE2018, and TE2021 indicate the average for 2000–02, 2008–10, 2016–18, and 2019–21, respectively.

more than the amount imported in TE2018 or from USD 79.48 million in 2018 to USD 129.03 million in TE2021. During this period, imports from Myanmar, Oman, the US, the EU, Bangladesh, and Norway increased by 298.4 percent, 269.4 percent, 197.8 percent, 114.2 percent, 77 percent, and 44.6 percent, respectively. On the other hand, imports from Singapore, Thailand, and Vietnam declined by 56.0 percent, 35.9 percent, and 23.2 percent, respectively (Table 2).

The increase in fish imports from Myanmar can be linked to the opening of the India-Myanmar land route in August 2018 through Manipur State's Moreh. Accordingly, this has facilitated the overnight imports of all kinds of fresh fish from Myanmar and has helped to address the demand-supply gap in fish in the northeastern states of India. Meanwhile, imports from Oman rapidly increased due to the India-Oman bilateral trading arrangements, visits of top-level leaders of both countries, and the increase in Oman's production of seafood products. Oman's total fish output in 2020 was 44.8 percent higher than that in 2019, and fish output reached 840,378 MT in 2020 (Oirere 2022). Thus, multiple factors have contributed to the rapid change in India's import sources in the last three years, namely, increased connectivity, strengthened trade partnerships, and changes in trade policies (e.g., ease of export restriction by Bangladesh).

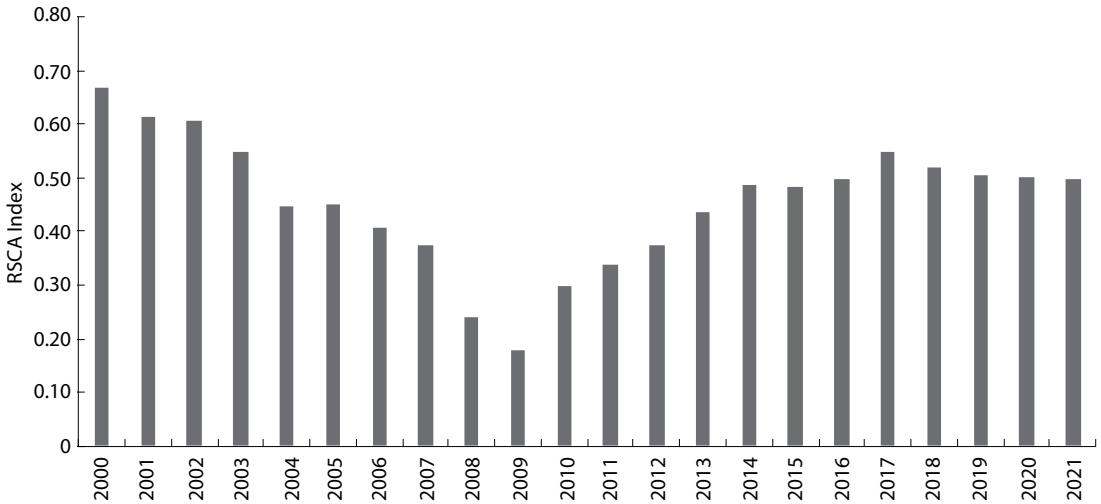
Revealed Comparative Advantage in India's Exported Fish and Fishery Products

Export to the world market

In this study, we use the RSCA index (equation 3) to measure India's RCA in exporting different fish and fishery products. India's exported fish and fishery products to the world has RCA in all the years considered in the study period (2000–2021) (Figure 3). However, RSCA values fluctuated across the years, gradually declining from 0.67 in 2000 to the lowest of 0.18 in 2009. After 2009, the RCA started to increase to 0.55 in 2017, which implies that India's exported fish and fishery products to the world has become more competitive. Accordingly, the sector's estimated RSCA value in the last three years (2019–2021) has been constant at 0.50.

Meanwhile, product-wise analysis reveals that out of India's eight categories of fish and

Figure 3. Revealed comparative advantage (RSCA index) of India's exported fish and fishery products to the world, 2000–2021



fishery products, the country has consistent RCA (2000–2021) only for three commodities, i.e., crustaceans, frozen fish (except for 2020 and 2021), and mollusks (except for 2019–2021) (Figure 4). India did not have a comparative advantage in exporting other fish and fishery products (live fish, fresh or chilled fish, fish fillet and other fish meat, dried/salted/in-brine/smoked fish, and other aquatic invertebrates) during the study period.

Export to individual markets

In this section, we use equation (3) to measure the comparative advantage of each exported fish and fishery product to the top 10 export destinations on a per-year basis (i.e., 2000–2021). Our analysis shows continuous RCA, continuous RCD, and mixed experiences (i.e., RCA in some years and RCD in other years). Table 3 summarizes the results of the comparative advantage analysis, whereas Table 4 reports the changes in the RCA of India's exported fish and fishery products to each top 10 destinations.

Based on the results, we observe three types of changes: (1) RCD in the initial years, then RCA in the later years; (2) RCA in the initial years, then RCD in the later years; and (3) no specific trends or consistent patterns, i.e., RCA in a year, RCD in the next year or two, and then again RCA or RCD.

Live fish (HS 0301). From 2000 to 2021 (except in 2018), India experienced RCA in exporting live fish to Hong Kong (Table 3). On the other hand, it had RCD in its live fish exports to the EU, Russia, Vietnam, and Canada (except in 2003) during the same period. It also had RCD in exporting to China during the initial years but had RCA in recent years (2004 and 2015–2018) (Table 4). The RCA and RCD of India's live fish exports to Japan, Thailand, the UAE, and the US show an inconsistent pattern from 2000 to 2021.

Rani, Immanuel, and Ranjan (2014) reported that India had made tremendous progress in exporting ornamental fish (an item included in live fish, HS 0301) from 1991 to 2009. The major export destination of Indian ornamental fish was Singapore, followed by Japan, the US, Malaysia, and then Germany. Their results also reveal that RCA values of India's live fish exports are fluctuating, which may be because India's export production highly depends on wild capture rather than on aquaculture.

Figure 4. Revealed symmetric comparative advantage (RSCA index) of India's different exported fish and fishery products to the world, 2000–2021

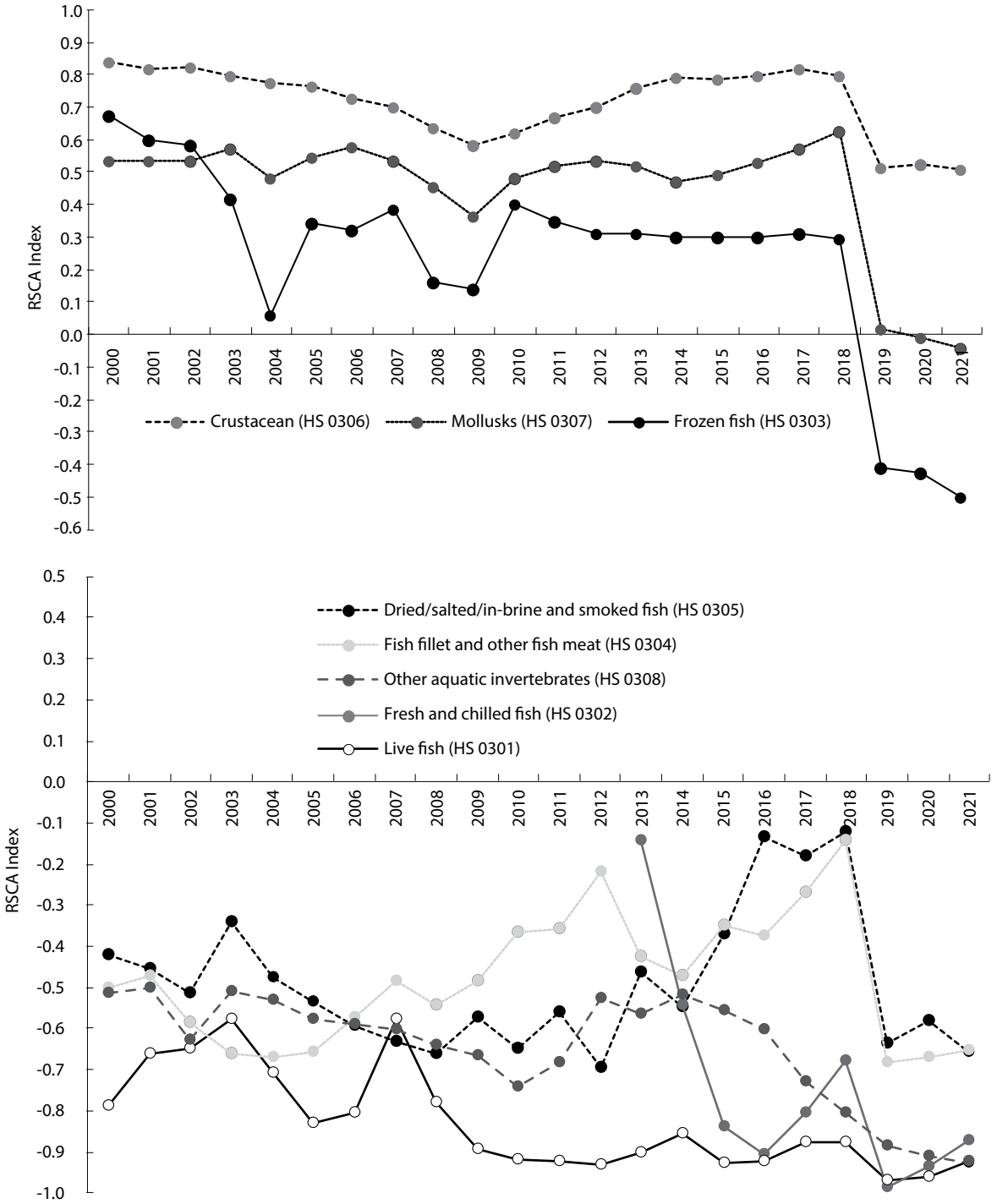


Table 3. Nature of revealed symmetric comparative advantage index of India's exported fish and fishery products to different destinations, 2000–2021

Products	Canada	China	Hong Kong	EU	Japan	Russia	Thailand	UAE	USA	Vietnam
Live fish	RCD (except 2003)	Mixed	RCA (except 2018)	RCD	Mixed	RCD	Mixed	Mixed	Mixed	RCD
Fresh or chilled fish	Mixed	Mixed	Mixed	RCD	RCD (except 2007)	Mixed	Mixed	Mixed	RCD	RCD
Frozen fish	RCD	RCA	Mixed	RCD	RCD	Mixed	Mixed	Mixed	RCD	Mixed
Fish fillet and other fish meat	RCD (except 2008)	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	RCD	RCD (except 2005, 2007, 2008)
Dried/salted/in-brine and smoked fish	RCD	RCD (except 2002, 2009)	RCA	RCD	RCD (except 2004)	RCD	Mixed	RCD	RCD	RCD (except 2000)
Crustaceans	Mixed	RCD (except 2017)	RCD	RCD	RCA	Mixed	Mixed	Mixed	RCA	Mixed
Mollusks	Mixed	Mixed	RCD (except 2003, 2004)	RCA	RCD	RCD	Mixed	RCD	RCD	Mixed
Other aquatic invertebrates	NA	NA	RCD	RCD	RCD	NA	Mixed	RCD	RCD	RCA

Notes:
Relative comparative advantage where RCA > 1 for every year from 2000 to 2021
Relative comparative disadvantage where RCA < 1 for every year from 2000 to 2021
Mixed pattern where RCA fluctuates over the period of 2000–21
NA = not available
RCA = revealed comparative advantage
RCD = revealed comparative disadvantage

Table 4. Classification of India's fish and fishery products according to their RCA index exported to different destinations, 2000–2021

Products	RCD→RCA[a]	RCA→RCD[b]	RCA↔RCD[c]
Live fish	China		Japan, Thailand, UAE, USA
Fresh or chilled fish	UAE	Canada, China	Hong Kong, Russia
Frozen fish	Vietnam, Thailand	Hong Kong, Russia, UAE	
Fish fillet and other fish meat	Japan	Hong Kong, EU	China, Russia, Thailand, UAE
Dried/salted/in brine fish		Thailand	
Crustaceans	Canada	Vietnam	Russia, UAE
Mollusks	Thailand, Vietnam	Canada	
Other aquatic invertebrates			Thailand

Notes:
[a]RCD → RCA indicates products that have RCD in the past years then have RCA at present.
[b]RCA → RCD indicates products "losing" their RCA during the period then RCD at present.
[c]RCA ↔ RCD indicates products that have RCA index fluctuating over a period.

Fresh and chilled fish (0302). India had RCD in exporting fresh and chilled fish to the EU, the US, Vietnam, and Japan (except in 2007) (Table 3). It had a mixed pattern of comparative advantage in exporting fresh and chilled fish to Canada, China, Hong Kong, Russia, Thailand, and the UAE. India had RCD in the initial years, then RCA in recent years in exporting the same commodity to the UAE (Table 4). On the other hand, the country enjoyed RCA in the initial years, but has experienced RCD in recent years in its fresh and chilled fish export products to Canada and China. In the case of Hong Kong and Russia, RCA pattern fluctuated across the years.

Frozen fish (HS 0303). From 2000 to 2021 (except 2016 and 2018), India had RCA in exporting frozen fish to China (see Table 3), and had RCD in its exports to Canada, the EU, Japan, and the US. It had a mixed pattern of comparative advantage in exporting frozen fish to Hong Kong, Russia, Thailand, and the UAE. India had RCD in exporting frozen fish to Vietnam and Thailand in the initial years, then RCA in recent years (see Table 4). On the other hand, it had an RCA in exporting frozen fish to Hong Kong, Russia, and the UAE in the initial years but RCD in recent years. Three countries (Vietnam, Thailand, and China) accounted for 81 percent of India's frozen fish exports, and Vietnam alone accounted for 45 percent in 2018 (see Table 1). On the other hand, these three countries accounted for 70 percent of India's exported frozen fish products, and China alone accounted for 38 percent in 2021. Vietnam's share was only 2.6 percent in 2021.

Fish fillet and other fish meat (HS 0304). In all the years of the study period, India's exported fish fillet and other fish meat products to the US, Canada (except 2008), and Vietnam (2005, 2007, and 2008) were at a comparative disadvantage (see Table 3). However, it had mixed RCD/RCA when exporting to the other major destinations (China, Hong Kong, the EU, Japan, Russia, Thailand, and the UAE). India experienced RCD in exporting fish fillets and other fish meat to Japan in the initial years, then had RCA in recent years (see Table 4). Conversely, the country's export of the same commodity to Hong Kong, the UAE, and the EU had RCA in the initial years, then RCD in recent years. Comparative advantage fluctuated across the years of the study period as the commodity was exported to China, Russia, Thailand, and the UAE.

Dried/salted/in-brine and smoked fish (HS 0305). India has consistently enjoyed RCA in exporting dried/salted/in-brine and smoked fish to Hong Kong (see Table 3). On the other hand, it had RCD in exporting the same commodity to Canada, the EU, Russia, the UAE, and the US. India experienced RCD in its dried/salted/in-brine and smoked fish exports in all the years of the study period except for 2004 to Japan, 2000 to Vietnam, and 2002 and 2009 to China. The country had mixed experiences in exporting to Thailand. India had RCA in exporting to Thailand for six years (2000, 2002, and 2004–07) and RCD in other years. India's export to Thailand had RCA in the initial years, then RCD in recent years (see Table 4).

Crustaceans (HS 0306). India has had comparative advantage in exporting crustaceans to the US and Japan in the last two decades (see Table 3). It had RCA in exporting the same commodity to Hong Kong and the EU in all years, and RCD in exporting to China in all years except 2017. It had mixed experience in exporting crustaceans to Canada, Russia, Thailand, the UAE, and Vietnam. India's exported crustaceans to Canada and the UAE has had comparative advantage since 2003 (see Table 4). On the other hand, its exports to Vietnam had RCA in the initial years, then RCD in recent years. Although the RCA of crustaceans fluctuated across the years during the study period, it had RCA in recent years.

Xinhua (2008), using the Balassa index, showed that India had RCA in its shrimp exports from 1990 to 2003, which is consistent with our findings. As such, crustaceans as an export commodity (export value of about USD 4.6 billion) deserves special attention. Crustaceans share more than 75 percent of India's exported fish and fishery products; the US, China, and the EU have been the major market for this commodity, accounting for more than three-fourths of India's exported crustaceans in 2021. China and Vietnam import a limited number of crustaceans for domestic consumption purposes; most of their imported crustaceans are used for processing and reexporting to other countries. In 2021, China and Vietnam had a share of 15.0 percent and 4.9 percent, respectively, of India's total exported crustaceans. In 2018, Vietnam had an 18.5 percent share of India's total crustacean exports, and China had 6.7 percent share. The crustacean industry depends mainly on several markets, which may not be a safe marketing strategy. Therefore, India must be careful in producing this commodity. For example, a disease outbreak, noncompliance with sanitary and phytosanitary standards, and trade disputes with the US, the EU, China, and Vietnam can affect the country's seafood industry.

Mollusks (HS 0307). India had a consistent comparative advantage in exporting mollusks to the EU during the entire study period (see Table 3). From 2000 to 2021, it had comparative disadvantage in exporting to Japan, Russia, the UAE, the US, and Hong Kong (except 2003 and 2004). It had a mixed RCA/RCD in its exports to Thailand and Vietnam (Table 4), experiencing RCD in the initial years then RCA in recent years. In the case of exporting mollusks to Canada, India enjoyed RCA in the initial years but RCD in recent years. Mollusks as an export commodity contributed 10.3 percent to India's export sector in 2021; the EU was its major market (sharing 54%), followed by China (11%), Thailand (10%), and the US (9%).

Other aquatic invertebrates (HS 0308). The listing of this commodity in the database started in 2013. India has RCA in exporting other aquatic invertebrates to Vietnam (see Table 3) and has experienced RCD in exporting to Hong Kong, the EU, Japan, the UAE, and the USA. It has inconsistent patterns in Thailand (Table 4).

Rani and Kumar (2016), using the Balassa index, showed that India had a comparative advantage in its total fish exports to the EU from 2000 to 2014, and this is consistent with our findings. The authors furthered that India had comparative advantage in exporting mollusks and crustaceans, but had comparative disadvantage in exporting frozen fish, fillets, and chilled and live fish to the EU.

Relative Competitiveness in Fish and Fishery Products Trade

Using Vollrath indices, we calculate the relative competitiveness (RC) of India's exports (RXA), imports (RMA), and trade (RTA) of fish and fishery products at the global level. Note that India mostly do not import fish and fishery products. Therefore, our RC analysis is limited to the world trade for total fish and fishery products.

Accordingly, Figure 5 shows that India had strong RC in its fish and fishery products trade with the rest of the world from 2000 to 2021, albeit the level of competitiveness fluctuated over the years. The RC values range between 6.47 (in 2013) and 5.17 (in 2008). India's positive RC values indicate that the country's trading of fish and fishery products has comparative advantage and is competitive. However, India's trade competitiveness declined after 2017 and then increased in 2021.

Note that Gopal et al. (2009), using the Vollrath index, reported that India did not have any comparative advantage in exporting finfishes from 2001 to 2005. From 2002 to 2007, India had RC in exporting all the fish and fish products (except for fish fillets) listed in the HS four-digit categories (i.e., live fish, fresh/chilled fish, frozen fish, dried fish, crustaceans, and mollusks) to the six major ASEAN countries (Chandran and Sudarsan 2012).

The COVID-19 Pandemic and India's Trade Performance

The COVID-19 pandemic has impacted global fish and fishery production, transportation, marketing, and trade as many countries, including India, imposed a lockdown for an extended period. To estimate the impact of the pandemic on India's export sector, we analyze the export-import trend from January 2017 to July 2022. We then measure India's market share in global export to quantify the impact of the pandemic on the country's

Figure 5. Revealed competitiveness in India's trade in fish and fishery products with the rest of the world, 2000–2021

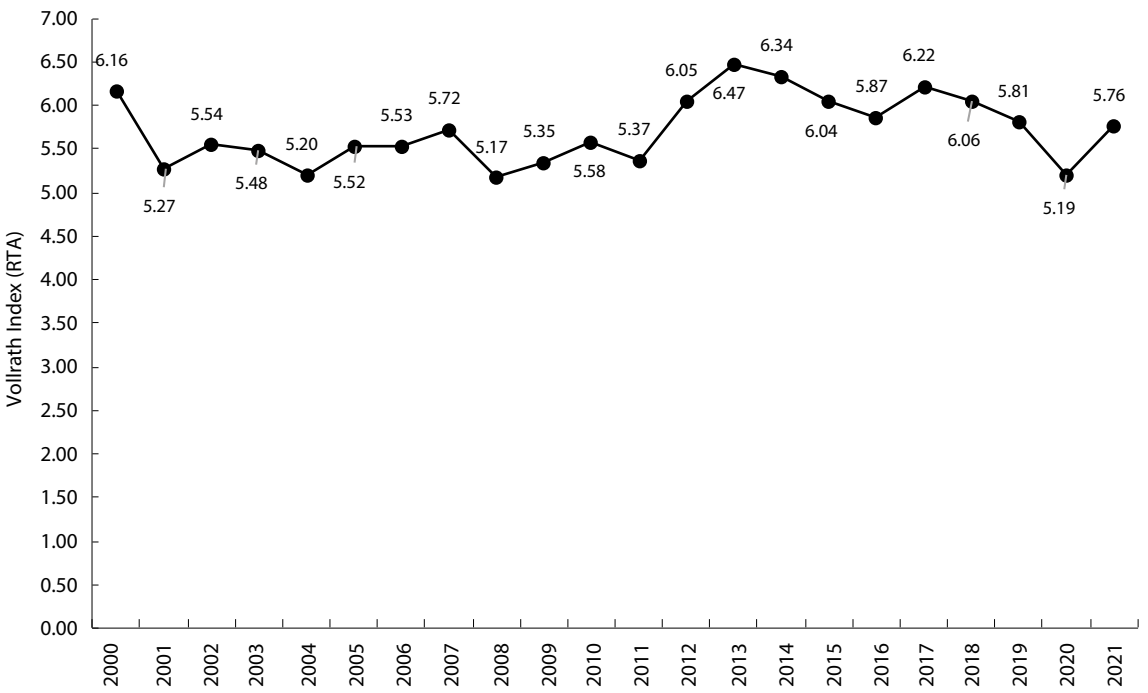
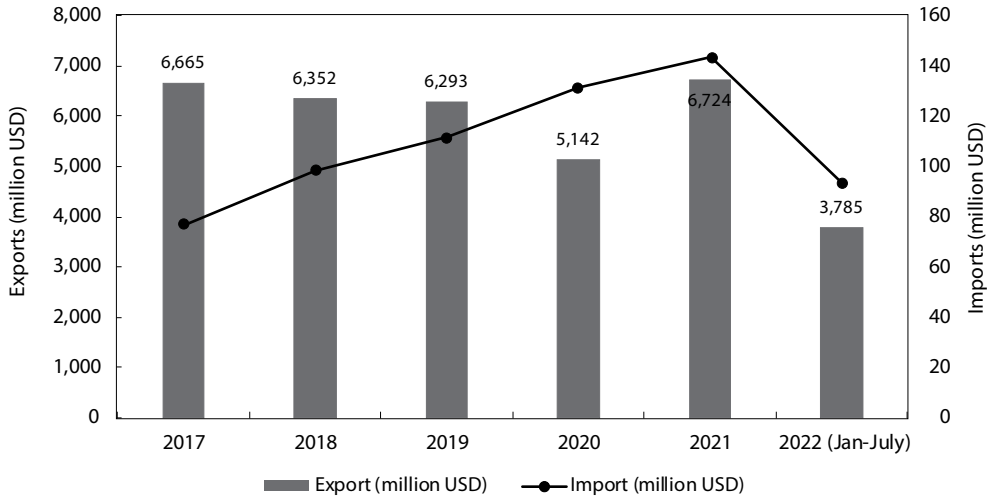


Figure 6. India's exported and imported fish and fishery products to and from the rest of the world, 2017–2022 (January–July)

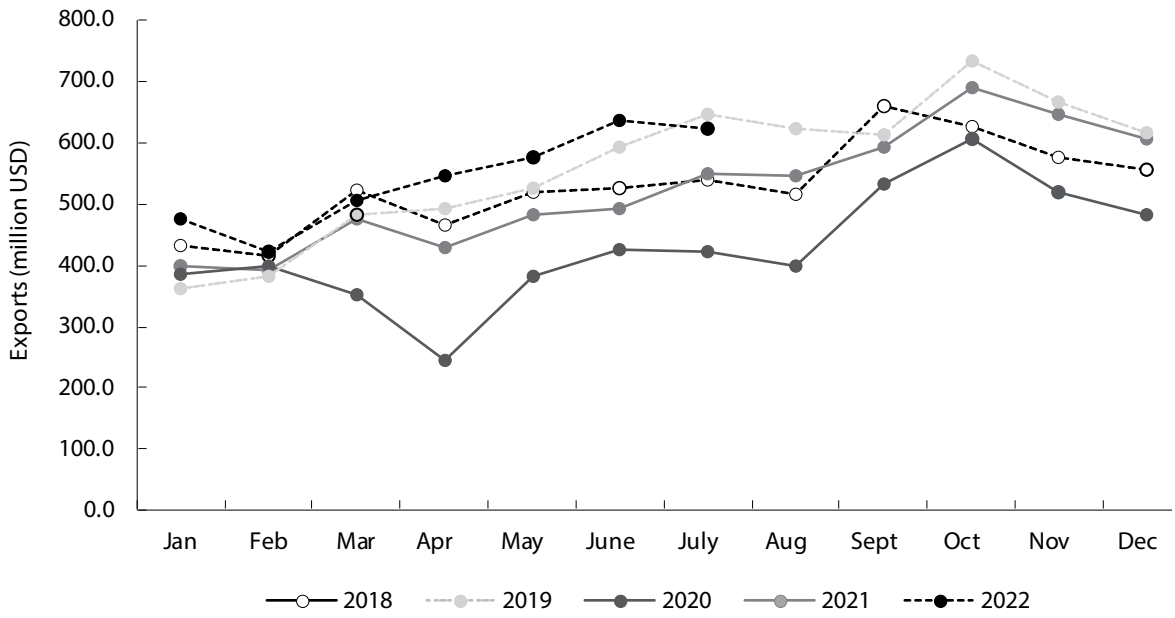


Source of raw data: UN Comtrade (2021)

export competitiveness. The larger the market share that a particular country controls, the greater its competitiveness would be in that market.

The pandemic has significantly affected India's trade of fish and fishery products (Figure 6). India's total exported fish and fishery products in 2020 declined by 18.3 percent at USD 5,150 million as compared to that in 2018; it then increased by 6.9 percent in 2021 at USD 6,735 million. On the other hand, India's total imported fish and fishery products was 33.1 percent higher in 2020 (USD 131.27 million) than in 2018;

Figure 7. Trends in India's monthly export of fish and fishery products to the rest of the world, 2018 January to 2022 July



Source of raw data: UN Comtrade (2021)

further, it was 45.9 percent higher in 2021 (USD 143.96 million) (UN Comtrade 2022).

The share of India's fish and fishery products in the total global exports declined from 5.3 percent in 2018 to 4.9 percent in 2020, and then increased to 5.6 percent in 2021. The trend in monthly exports reveal that monthly exports in 2020 were 47 percent lower in April 2020 than in April 2018. The reduced export situation persisted until March 2021 (Figure 7). Thereafter, monthly exports started to increase over the corresponding months in 2018. However, the causes of the increased value of exports in 2021 must be considered carefully due to the influence of external factors such as the significant increase in international food prices, including fish prices, in that year.

Our findings also corroborate those of other studies. FAO reported that the total value of India's exports of aquatic products reached USD 5.8 billion in 2020, which is lower than the USD 7.2 billion in 2017 (FAO 2022).

CONCLUSIONS

India's fish and fishery export products to the world has increased 4.9 times from 2000 to 2021 or from USD 1,372.34 million in 2000 to USD 6,734.83 million in 2021. Over the past 20 years, India's imported fish and fishery products has also increased 31.4 times during the same period or from USD 4.59 million in 2000 to USD 143.96 million in 2021.

India's fish and fishery industry has access to major global markets like the EU, the US, and Japan. From 2000 to 2021, India experienced a revealed comparative advantage (RCA) in exporting fish and fishery products to the world. During the same period, India had RCA in exporting live fish to Hong Kong; fresh and chilled fish to the UAE (in recent years); frozen fish to China, Hong Kong, Thailand (recent years), and Vietnam (recent years); fish fillets and other fish meat to Japan (recent years); dried fish to Hong Kong; crustaceans to Japan, the US, and Canada (recent years); mollusks to the EU, Thailand (recent years), and Vietnam (recent years); and other aquatic invertebrates to Vietnam. India had a revealed comparative disadvantage (RCD) in exporting fresh and chilled fish to the EU, Japan, the US, and Vietnam, and fish fillet and other fish meat to the US, Canada, and Vietnam.

India could gain from exporting high-value products (crustaceans, fish fillets, and mollusks) to developed countries like the US, the EU, Japan, and the UAE. Vietnam seems to be the destination for 99.97 percent of India's other aquatic invertebrates as the commodity has an RCA if it is exported to Vietnam. Therefore, continuing to target Vietnam and, if needed, specializing these products for the Vietnamese market could benefit India. However, note that China and Vietnam import fish and fishery products primarily as inputs for their export-oriented processing industries; they also import a limited quantity for their domestic consumption.

Future studies need to examine the impact of trade policies, preferential trading arrangements, and sanitary and phytosanitary standards on India's exported fish and fishery products. We also suggest for researchers to investigate the implications of investing in the seafood processing industry in order to integrate the seafood industry and to increase the export of value-added fish products.

Our study shows that fish and fishery products trade is dynamic and often experiences rapid change to adapt to trade policies. Therefore, regular monitoring could help India to take the required measures on time.

REFERENCES

Adhikari, S., and U. Deb. 2020. "Revealed Comparative Advantage in Export of Aquaculture Products by the US." *Journal of Agricultural, Environmental, and Consumer Sciences* 20: 36–49.

Amirnejad, H., A.S. Ahmadzade, and R.E. Kenari. 2020. "A Comparative Advantage Analysis of Fishing Sector and Its Impact on Iran's Economic Development." *Iranian Journal of Fisheries Sciences* 19(1): 386–400.

Balassa, B. 1965. "Trade Liberalisation and 'Revealed' Comparative Advantage." *The Manchester School* 33(2): 99–123. https://doi.org/10.1111/j.1467-9957.1965.tb00050.x

Bojnec, S., and I. Fertő. 2009. "Agro-Food Trade Competitiveness of Central European and Balkan Countries." *Food Policy* 34(5): 417–25. https://doi.org/10.1016/j.foodpol.2009.01.003

———. 2012. "Complementarities of Trade Advantage and Trade Competitiveness Measures." *Applied Economics* 44(4): 399–408. DOI: 10.1080/00036846.2010.508725

Bowen, H.P. 1983. "On the Theoretical Interpretation of Indices of Trade Intensity and Revealed Comparative Advantage." *Weltwirtschaftliches Archiv* 119(3): 464–72. http://www.jstor.org/stable/40439150

Cai, J., P.S. Leung, and M. Loke. 2007. "Comparative Advantage of Selected Agricultural Products in Hawaii: A Revealed Comparative Advantage Assessment." *Report No. EI11*. Honolulu, HI: University of Hawaii.

Chandran, B.P.S., and P.K. Sudarsan. 2012. "Revealed Comparative Advantage (RCA) and Trade Complementarity between India-ASEAN Trade: A Study with Reference to Fisheries Sector." *SSRN Paper*. Amsterdam, NL: Elsevier. http://dx.doi.org/10.2139/ssrn.2054132

Chang, C.L., M. McAleer, and D.K. Nguyen. 2019. "US Antidumping Petitions and Revealed Comparative Advantage of Shrimp Exporting Countries." *Reviews in Aquaculture* 11(3): 782–792.

Dalum, B., K. Laursen, and G. Villumsen. 1998. "Structural Change in OECD Export Specialisation Patterns: Despecialisation and 'Stickiness'." *International Review of Applied Economics* 12(3): 423–43. https://doi.org/10.1080/02692179800000017

Dao, T. 2021. "Vietnam Faces USD 480 Million Annual Damage from European Red Card." *SeafoodSource*, 13 August 2021. https://www.seafoodsource.com/news/environment-sustainability/vietnam-faces-usd-480-million-annual-damage-from-european-red-card#:~:text=Vietnam%20faces%20a%20loss%20of,called%20%E2%80%9Cred%20card%E2%80%9D%20penalty

De Benedictis, L., and M. Tamberi. 2001. "A Note on the Balassa Index of Revealed Comparative Advantage." *SSRN Paper.* Amsterdam, NL: Elsevier. http://dx.doi.org/10.2139/ssrn.289602

Destiningsih, R., R.R. Sugiharti, L.T. Laut, S.N. Safiah, and A. Achsa. 2020. "Competitiveness Identification of Fisheries Export in Indonesia." *IOP Conference Series: Earth and Environmental Science* 530(1): 012017. DOI 10.1088/1755-1315/530/1/012017

FAO (Food and Agriculture Organization of the United Nations). 2022. *The State of World Fisheries and Aquaculture 2022: Towards Blue Transformation*. Rome, IT: FAO. https://doi.org/10.4060/cc0461en

GOI (Government of India). 2022. *Economic Survey 2021–22*. New Delhi, IN: Ministry of Finance, Government of India, New Delhi, India.

Gopal, N., P. Jeyanthi, V. Geethalakshmi, and G.R. Unnithan. 2009. "Indian Finfish Exports: An Analysis of Export Performance and Revealed Comparative Advantage." *Agricultural Economics Research Review* 22(2): 291–97.

Granabetter, D. 2016. "Revealed Comparative Advantage Index: An Analysis of Export Trade in the Austrian district of Burgenland." *Review of Innovation and Competitiveness: A Journal of Economic and Social Research* 2(2): 97–114.

Herath, H.M.T.N.B., and L.N. Wijewardene. 2014. "Ornamental Fish Trade in Sri Lanka: An Economic Perspective." *International Research Journal of Environment Sciences* 3(8): 40–5.

Ismail, M.M., F.M. Arshad, Z. Yusop, and K. Mohd, eds. 2013. *Competitiveness of Food and Feed Industry in Malaysia*. Selangor, MY: University Putra Malaysia Press.

Khai, N.X., M.M. Ismail, and S.F. Sidique. 2016. "Consistency Tests of Comparative Advantage Measures: An Empirical Evidence from the Malaysian and Selected Asian Shrimp Products." *International Food Research Journal* 23(6): 2752–58.

Kiet, N.T., and Z. Sumalde. 2008. "Comparative and Competitive Advantage of the Shrimp Industry in Mekong River Delta, Vietnam." *Asian Journal of Agriculture and Development* 5(1): 57–79.

Krugman, P.R., M. Obstfeld, and M.J. Melitz. 2018. *International Economics: Theory & Policy 11th Edition*. London, UK: Pearson Education.

Kuldilok, K.S., P.J. Dawson, and J. Lingard. 2013. "The Export Competitiveness of the Tuna Industry in Thailand." *British Food Journal* 5(3): 328–41. https://doi.org/10.1108/00070701311314174

Lafay, G. 1992. "The Measurement of Revealed Comparative Advantages." In *International Trade Modelling,* edited by M.G. Dagenais and P.A. Muet, 209–34. London, UK: Chapman & Hall.

Laursen, K. 2015. "Revealed Comparative Advantage and the Alternatives as Measures of International Specialization." *Eurasian Business Review* 5(1): 99–115.

Leung, P.S., and J. Cai. 2008. "A Review of Comparative Advantage Assessment Approaches in Relation to Aquaculture Development." In *Species and System Selection for Sustainable Aquaculture* edited by P.S. Leung, C-S. Lee, and P.J. O'Bryen, 43–56. Ames, IA: Blackwell Publishing.

Ling, B.H., P.S. Leung, and Y.C. Shang. 1996. "Export Performance of Major Cultured Shrimp Producers in the Japanese and US Markets." *Aquaculture Research* 27(10): 775–86. https://doi.org/10.1046/j.1365-2109.1996.t01-1-00794.x

Luo, X.F., Y.H. Han, and Z.W. Li. 2017. "Comparing Quantitative Analysis on Revealed Comparative Advantages of Aquatic Products Trade of China and ASEAN Based on 21st Century Maritime Silk Road." *IOP Conference Series: Earth and Environmental Science* 94(1): 012032. DOI 10.1088/1755-1315/94/1/012032

Ma, J., and J. Xiao. 2010. "RCA Analysis on Norwegian Salmon Exports to China." *Asian Social Science* 6(8): 100–3. DOI:10.5539/ass.v6n8p100

Memedović, O. 1994. *On the Theory and Measurement of Comparative Advantage: An Empirical Analysis of Yugolslav Trade in Manufactures with the OECD Countries 1970–1986*. Amsterdam, NL: Thesis Publishers.

Ministry of Commerce and Industry, India. 2022. "Export Promotion (Marine Products)." Accessed 20 October 2022. https://commerce.gov.in/about-us/divisions/export-products-division/export-promotion-marine-products/

Monke, E. A., and S.R. Pearson. 1989. *The Policy Analysis Matrix for Agricultural Development*. New York: Cornell University Press.

Nisar, U., M. Yongtong, and N.R. Kumar. 2020. "A Competitive Analysis of Indian Fish Export to USA: Growth, Performance, Comparative Advantages and Instability." *Indian Journal of Geo Marine Sciences* 49(05): 790–7.

Oirere, S. 2022. "Deal Inked for New Tuna and Sardine Canning Complex in Oman." *SeafoodSource,* 7 June 2022. https://www.seafoodsource.com/news/processing-equipment/deal-inked-for-new-tuna-and-sardine-canning-complex-in-oman#:~:text=FDO%2C%20through%20its%20affiliate%20firm,(MT)%20of%20seafood%20annually

Oktopura, A.A.D., A. Fauzi, K. Sugema, and H. Mulyati. 2020. "Aquaculture Performance in Indonesia: Economics and Social Perspectives." *IOP Conference Series: Earth and Environmental Science* 493(1): 012003.

Polymeros, K., E. Tsakiridou, and K. Mattas. 2005. "Assessing the Competitiveness of EU Mediterranean Fisheries and Aquaculture Industries." Paper presented at the 95th EAAE Seminar, 9–11 December 2005, Rome, Italy.

Rani, P., and N.R. Kumar. 2016. "Status and Competitiveness of Fish Exports to European Union." *Fishery Technology* 53(1): 69–74.

Rani, P., S. Immanuel, and N. Ranjan. 2014. "Ornamental Fish Exports from India: Performance, Competitiveness and Determinants." *International Journal of Fisheries and Aquatic Studies* 1(4): 85–92.

Ruffin, R. 2002. "David Ricardo's Discovery of Comparative Advantage." *History of Political Economy* 34(4): 727–48.

Seyoum, B. 2007. "Revealed Comparative Advantage and Competitiveness in Services: A Study with Special Emphasis on Developing Countries." *Journal of Economic Studies* 34(5): 376–88.

Shang, Y.C., P. Leung, and B.H. Ling. 1998. "Comparative Economics of Shrimp Farming in Asia." *Aquaculture* 164(1–4): 183–200.

Tan, L., C. Wu, and Y. Qu. 2020. "Measuring the International Trade Competitiveness of China's Aquatic Products from 2008–18." *Journal of Coastal Research* 106(SI): 157–60. https://doi.org/10.2112/SI106-038.1

Thein, K.T.T. 2020. "Comparative study of International Demand for Myanmar's Fishery Export." Paper presented at the 14th International Joint Conference of YUE, KOMYRA, KHU & KTRA, 6–8 February 2020, Yangon University of Economics, Yangon, Myanmar.
https://unstats.un.org/wiki/display/comtrade/Differences+between+Imports+and+Exports%2C+Reporters+and+Partners

Traesupap, S., Y. Matsuda, and H. Shima. 1999. "Diversification of Shrimp Products in the Japanese and US Markets during the 1990s." *Aquaculture Economics & Management* 3(2): 167–75. DOI: 10.1080/13657309909380243

UN Comtrade. 2021. "Differences between Imports and Exports, Reporters and Partners." *UN Statistics Wiki*. Last modified 12 May 2021.

———. 2022. "Fish and Fishery Products." *UN Comtrade Database*. https://comtrade.un.org/data/

VASEP (Vietnam Association of Seafood Exporters and Producers). 2021. "Increasing the 'Power' for the Seafood Processing Sector." Accessed 9 April 2022. https://seafood.vasep.com.vn/total-seafood-trade/news/increasing-the-power-for-the-seafood-processing-sector-22578.html

Vollrath, T.L. 1991. "A Theoretical Evaluation of Alternative Trade Intensity Measures of Revealed Comparative Advantage." *Weltwirtschaftliches Archiv* 127(2): 265–280.

Wati, L.A., W-I. Chang, and M.M. Mustadjab. 2013. "Competitiveness of Indonesian Shrimp Compared with Thailand Shrimp in Export Market." *Wacana Journal of Social and Humanity Studies* 16(1): 24–31.

Wijnands, J.H.M., H.J. Bremmers, B.M.J. van der Meulen, and K.J. Poppe. 2008. "An Economic and Legal Assessment of the EU Food Industry's Competitiveness." *Agribusiness: An International Journal* 24(4): 417–39. https://doi.org/10.1002/agr.20167

———. 2010. "Competitiveness and Innovativeness of the EU Dairy Industry." Paper presented at the 9th Wageningen International Conference on Chain and Network Management (WICaNeM), 26–28 May 2010, Wageningen, The Netherlands.

Xinhua, Y. 2008. "Comparative Advantage Analysis of Shrimp Production in Asia." *Aquaculture Asia* 13(1): 33.

Yeats, A.J. 1985. "On the Appropriate Interpretation of the Revealed Comparative Advantage Index: Implications of a Methodology Based on Industry Sector Analysis." *Weltwirtschaftliches Archiv* 121(1): 61–73.

Yusuf, M., Y.K. Sya'di, B. Pranata, and D. Yonata. 2021. "The Competitiveness of Indonesian Shrimp Export in Malaysia and Singapore Markets." *International Journal of Management* 12(2): 863–74. DOI: 10.34218/IJM.12.2.2021.084

Zhang, H., and K. Chen. 2019. "Assessing agricultural trade comparative advantage of Myanmar and its main competitors: findings from UN Comtrade." *IFPRI Discussion Paper* No. 01823. Washington DC, VA: International Food Policy Research Institute.